CLAIMS

What is claimed is:

1. An implantable medical device comprising:

a semiconductor substrate;

an epitaxial layer overlying the semiconductor substrate;

a power transistor formed in the epitaxial layer having a first electrode, a control electrode, and a second electrode wherein a breakdown voltage of the power transistor is greater than 100 volts and wherein current flow of the transistor is vertical through the epitaxial layer to the semiconductor substrate; and

a backside contact coupling to the first electrode of the power transistor.

2. The implantable medical device as recited in claim 1 further including:

an active area region in the epitaxial layer; and

a plurality of transistor cells formed in the active area region wherein the power transistor comprises the plurality of transistor cells coupled in parallel.

3. The implantable medical device as recited in claim 2 further including a high voltage termination region surrounding the active area region.

4. The implantable medical device as recited in claim 3 wherein the semiconductor substrate has a lower resistivity than the epitaxial layer.

5. The implantable medical device as recited in claim 4 wherein the backside contact comprises:

at least one deep trench etched through the epitaxial layer exposing the semiconductor substrate wherein the at least one deep trench is etched in an area outside the high voltage termination region; and

a first electrode contact region coupling to the semiconductor substrate exposed by the at least one deep trench, the first electrode contact region overlying the epitaxial layer.

6. The implantable medical device as recited in claim 5 wherein the second electrode contact region couples to a surface of the epitaxial layer in the active area region corresponding to the second electrode.

7. The implantable medical device as recited in claim 6 wherein the control electrode contact region overlies the epitaxial layer in the active area region and couples to the control electrode.

8. The implantable medical device as recited in claim 7 further including solder bumps formed on the first electrode contact region, the control electrode contact region, and the second electrode contact region.

9. The implantable medical device as recited in claim 8 further including:

a housing; and

a substrate in the housing wherein the solder bumps of the first electrode contact region, the control electrode contact region, and the second electrode contact region are coupled to interconnect on the substrate and wherein the interconnect couples to other circuitry of the implantable medical device.

10. The implantable medical device as recited in claim 9 wherein the implantable medical device is a defibrillator.

11. The implantable medical device as recited in claim 5 further including a metal layer formed on and coupled to an exposed surface of the semiconductor substrate.

12. The implantable medical device as recited in claim 4 wherein the backside contact comprises:

a deep trench etched through the semiconductor substrate and the epitaxial layer exposing a first electrode contact region; and

a conductive layer overlying the semiconductor substrate further including the conductive layer formed on the side walls and a bottom of the deep trench to couple to the first electrode contact region.

13. A method of manufacturing a medical device comprising the steps of:

providing a semiconductor substrate having an epitaxial layer formed thereon;

forming a power transistor in the epitaxial layer having a first electrode, a control electrode, and a second electrode;

etching a deep trench through the epitaxial layer exposing the semiconductor substrate; and

forming a first electrode contact region, a control electrode contact region, and second electrode contact region overlying the epitaxial layer coupling respectively to the first electrode, the control electrode, and the second electrode wherein the first electrode contact region couples to an exposed area of the semiconductor substrate in the deep trench.

14. The method of manufacturing a medical device as recited in claim 13 further including a step of forming at least one solder bump on the first electrode contact region, the control electrode contact region, and the second electrode contact region.

15. The method of manufacturing a medical device as recited in claim 14 further including the steps of:

aligning solder bumps on a die of the power transistor to a substrate;

placing the solder bumps on the die of the power transistor in contact with the substrate;

reflowing the solder bumps to physically and electrically couple to the substrate; and

placing the substrate in a housing of the medical device.

16. The method of manufacturing a medical device as recited in claim 13 further including the steps of:

etching to expose a polysilicon layer corresponding to the gate electrode;

etching to expose a surface of the epitaxial layer corresponding to the second electrode;

etching to expose a surface of the epitaxial layer corresponding to the deep trench;

forming an oxide layer overlying the power transistor;

forming a silicon nitride layer overlying the oxide layer;

forming a photoresist layer overlying the silicon nitride layer;

patterning the photoresist for forming the deep trench;

etching the silicon nitride layer;

etching the oxide layer such that the surface of the epitaxial layer is exposed corresponding to the deep trench;

etching the deep trench; and

removing the photoresist layer.

17. The method of manufacturing a medical device as recited in claim 16 further including the steps of:

removing the silicon nitride layer;

removing the oxide layer; and

forming a conductive layer.

18. The method of manufacturing a medical device as recited in claim 17 further including the steps of:

forming a layer of positive tone polyimide over the conductive layer;

patterning the layer of positive tone polyimide such that the positive tone polyimide remains over the conductive layer on sidewalls and a bottom of the deep trench and areas corresponding to the first electrode contact region, the control electrode contact region, and the second electrode contact region;

etching the conductive layer; and

removing the layer of positive tone polyimide.

19. A defibrillator comprising:

a housing for the defibrillator;

a substrate within the housing; and

at least one device having a plurality of contact areas flip-chip mounted to the substrate wherein at least one of the plurality of contact areas includes a backside contact coupled thereto.

20. The defibrillator as recited in claim 19 further including at least one lead coupling to the at least one device.

21. The defibrillator as recited in claim 20 wherein a distal end of the at least one lead includes an electrode for coupling to targeted tissue for providing a therapy.